A NEW SPECIES OF TRICHOSTRONGYLID WORM OF THE GENUS COOPERIA FROM THE CARABAO IN THE PHILIPPINE ISLANDS, WITH A REVIEW OF THE GENUS

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Under date of September 9, 1927, Dr. Angel K. Gomez, of the College of Veterinary Science of the University of the Philippines, forwarded to the writer a portion of the small intestine of a carabao calf (*Bubalus bubalus*) from Los Baños, Laguna, with the information that the animal had died from inanition and was extremely emaciated before it died. Doctor Gomez said that on post-morten examination the small intestine was found to contain nodules throughout its length and that teased preparations of the nodules revealed the presence of small roundworms.

Examination of the material by the writer showed the mucosa to be riddled with small, conspicuously raised nodules, varying from about 3 to 5 mm. in diameter, the summit of each nodule being more or less depressed and containing a small opening into a channel of communication between the parasite and the lumen of the intestine. Each nodule contains a single worm which is rather deeply imbedded in the mucosa and is very much twisted, the twists being due, apparently, to the technic of fixation. The worms belong to the genus *Cooperia* and represent a heretofore undescribed species for which the name *Cooperia nodulosa* is proposed. On the evidence this worm must be regarded as pathogenic and probably of economic importance.

COOPERIA NODULOSA, new species

Specific diagnosis—Cooperia: The head (fig. 1) varies in diameter with the degree of cuticular expansion and ranges from about 47μ to slightly over 50μ and bears 4 submedian papillae and 2 amphids or so-called lateral papillae. The esophagus (pl. 1, fig. 1) is slightly less than 0.5 mm. long in the male and from 0.5 mm. to slightly longer in the female, with a maximum diameter of 46μ. The nerve ring is located slightly posterior to the middle of the esophagus.

Male.—The male is about 7.2 mm. long by about 218μ in maximum width in the region of the spicules where the body is decidedly swollen. The externo-lateral ray (pl. 1, fig. 2) is more slender than the latero-ventral ray which is the thickest of all rays; the externo-lateral ray comes next in thickness; the medio-lateral and postero-lateral rays have about the same thickness; the externo-dorsal is next in thickness, and the ventro-ventral is the most slender of the paired rays; the tips of the paired rays, that is, all rays other than the dorsal ray, come close to the edge of the bursa, those of the medio-lateral and postero-lateral rays being most closely approximated to each other; the dorsal rays (pl. 1, fig. 3) bifurcates, each terminal branch ending in two blunt digitate processes; each terminal stem of the dorsal ray gives off a branch in its posterior portion having a more or less horizontal direction along the transverse axis of the worm. The spicules (pl. 1, fig. 4) are from 304 to 320μ long and are provided with seven tooth-like processes directed toward the median line in its posterior portion.

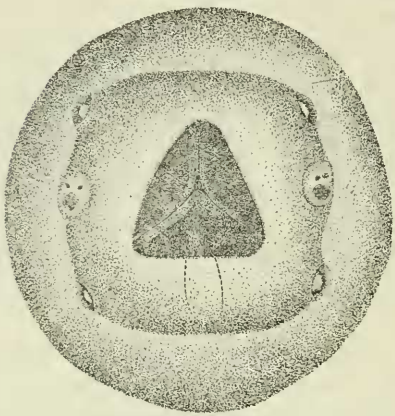

FIG. 1.—COOPERIA NODULOSA. TOP VIEW OF HEAD

Female.—The female is slightly over 11 mm. long by about 200μ in maximum width. The vulva (pl. 1, fig. 5), located at a distance of 2 mm. from the tip of the tail, is transversely elongated and is covered by a prominent cuticular linguiform flap. The combined lengths of the ovejectors, including the sphincters, is about 440μ. The tail (pl. 1, fig. 6) is about 210μ long and tapers to a point. The eggs are from 40 to 51μ long by 31μ wide.

Host.—Bubalus bubalus.

Location.—In nodules in mucosa of small intestine.

Locality.—Los Baños, Laguna, P. I.

Type specimens.—U. S. National Museum No. 24863.

Paratypes.—U. S. National Museum Nos. 24864 and 24865.

Genus COOPERIA

The genus *Cooperia* was proposed by Ransom (1907) who assigned to it four species as follows: *Cooperia curticei* (Railliet, 1893) (=*Cooperia curticii* Giles, 1892); *Cooperia punctata* (Schnyder, 1907); *Cooperia oncophora* (Railliet, 1898); and *Cooperia pectinata* Ransom, 1907. Since 1907 the following species have been added to

the genus: *Cooperia alata* Railliet and Henry, 1909; *Cooperia macieli* (Travassos, 1915); *Cooperia elegans* Travassos, 1921; *Cooperia falsa* Travassos, 1921; *Cooperia harkeri* (Stödter, 1901); *Cooperia bisonis* Cram, 1925; and *Cooperia fuelleborni* Hung, 1926.

So far as concerns *Cooperia alata* Railliet and Henry, 1909, from the intestine of a macacus monkey, the specific description, which is based on a male, is very brief and is unaccompanied by illustrations. Railliet and Henry say that the cuticle of the body has about 16 longitudinal lines, and this morphological feature is characteristic of the genus *Cooperia*. However, they also say that *C. alata* possesses a gubernaculum, and this structure is not known to be present in the four species referred to this genus by Ransom in 1907 nor in any other species that definitely belongs to it.

Cooperia macieli (Travassos, 1915) is described from the stomach of *Dasypus novemcinctus* (=*Tatus novemcinctus*) and is well illustrated in Travassos's paper on the family Trichostrongylidae published in 1921. Although the latero-ventral ray is larger than the ventro-ventral ray as shown in his illustrations and described in his text, whereas in other species of the genus the ventro-ventral ray is much more slender than the latero-ventral ray, the species in question has the primary characters of the genus *Cooperia*.

Cooperia elegans Travassos, 1921, from the small intestine of *Saimiris sciurea*, and *Cooperia falsa* Travassos, 1921, from the stomach of *Cabassus unicinctus* are described briefly without illustrations, and the descriptions contain no characters on the basis of which the worms can be assigned with certainty to the genus *Cooperia*. For the present, at least, these two species must be regarded as having doubtful generic affinities, and until more detailed descriptions with figures are published the writer considers that there is a lack of evidence on which to definitely assign these species to the genus *Cooperia*.

Cooperia harkeri Stödter, 1901, from cattle, is placed in this genus by Fiebiger (1923). Harker's (1893) figure shows that the species in question does not belong to the genus *Cooperia*. In the opinion of Ransom (1911), this species is identical with *Ostertagia ostertagi*.

Cooperia fuelleborni Hung, 1926, from *Kobus ellipsiprymnus* is very closely related to *Cooperia curticei*, as noted by Hung, his differentiating characters not being sufficient, in the opinion of the writer, to warrant the erection of new species, and in this paper *C. fuelleborni* is regarded as a synonym of *C. curticei*.

The following key will serve to differentiate the known species of the genus *Cooperia* and to indicate the position of *Cooperia nodulosa* in the genus:

KEY TO DESCRIBED SPECIES OF COOPERIA

1. Species placed in, but not definitely recognizable as belonging to, the genus *Cooperia* ..... 2.
   Species definitely recognizable as belonging to the genus *Cooperia* ..... 3.
2. Gubernaculum present; spicules 120μ to 130μ long, terminating in two processes of different shape and size; male 2.9 to 3.5 mm. long; female 4.3 to 4.9 mm. long ..... **Cooperia elegans.**
   Gubernaculum absent; spicules 134μ to 156μ long, terminating in three processes of different shape and size; male 4.5 to 6 mm. long; female 4.3 to 4.9 mm. long ..... **Cooperia falsa.**
3. Gubernaculum present; spicules 115μ long, with a recurved hook located at a distance of 45μ from tip; male 2.8 mm. long; female unknown. **Cooperia alata.**
   Gubernaculum absent; spicules more than 115μ long and without a recurved hook in posterior third ..... 4.
4. Ventro-ventral ray thicker than latero-ventral ray; spicules 170 to 180μ long, each with median process 120μ long, and each spicule terminating in two slender processes; male 7 to 9 mm. long; female 7 to 11 mm. long. **Cooperia macieli.**
   Ventro-ventral ray more slender than latero-ventral ray; spicules not ending in two processes ..... 5.
5. Spicules over 300μ long, with 7 toothlike structures in the posterior portion; female vulva covered by a linguiform flap; male 7.2 mm. long; female 11 mm. long ..... **Cooperia nodulosa.**
   Spicules not over 300μ long and without toothlike structures ..... 6.
6. Spicules less than 200μ in length ..... 7.
   Spicules more than 200μ in length ..... 8.
7. Branches of dorsal ray curved to form a lyre-shaped structure; spicules 135 to 185μ long; vulva with transverse slit; male 4.6 to 7.3 mm. long; female 5.4 to 7.8 mm. long ..... **Cooperia curticei.**
   Branches of dorsal ray nearly straight, almost parallel; spicules 120 to 150μ long; vulva crescentic in shape, elongated longitudinally ..... **Cooperia punctata.**
8. Spicules 224 to 240μ long; vulva covered by a large linguiform process; male 7.2 to 7.8 mm. long; female 8 to 9.5 mm. long ..... **Cooperia bisonis.**
   Spicules 240 to 300μ long; vulva not covered by a linguiform process ..... 9.
9. Main branches of dorsal ray widely divergent, forming U-shaped arch with cleft tips; spicules 240 to 300μ long; terminal portion of female with annular striations; combined lengths of muscular ovejectors about 700μ; male 5.5 to 9 mm. long; female 6 to 8 mm. long ..... **Cooperia oncophora.**
   Main branches of dorsal ray close together and parallel, with uncleft tips; spicules 240 to 300μ long, with corrugated edge in middle third; terminal portion of female sharply pointed and not marked with annular striations; combined lengths of muscular portions of ovejectors about 300μ; male 7 mm. long; female 7.5 to 9 mm. long ..... **Cooperia pectinata.**

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EXPLANATION OF PLATE

Cooperia nodulosa, new species

FIG. 1. Anterior portion.
2. Male bursa.
3. Male bursa showing dorsal ray.
4. Spicules.
5. Female showing region of vulva.
6. Female tail.

a., anus.
d., dorsal ray.
e. d., externo-dorsal ray.
e. l., externo-lateral ray.
l. v., latero-ventral ray.
m. l., medio-lateral ray.
n. r., nerve ring.
oes., esophagus.
p. l., postero-lateral ray.
v. v., ventro-ventral ray.